

Indicator: Number and Percent of Days with AQI Values >100 (001)

The Air Quality Index (AQI) provides information on pollutant concentrations of ground level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Formerly known as the Pollutant Standard Index (PSI), this nationally uniform air quality index is used by state and local agencies for reporting daily air quality and air quality related health advisories to the public.

In 1999, the AQI was updated to reflect the latest science on air pollution health effects and to make it more appropriate for use in contemporary news media (EPA 2003, pg 53). It also serves as a basis for community-based programs that encourage the public to take action to reduce air pollution on days when levels are projected to be of concern. The index has been adopted by many other countries (e.g., Mexico, Singapore, and Taiwan) to provide the public with information on air quality.

The AQI is based on pollutant concentration data measured by the State and Local Air Monitoring Stations (SLAMS). The AQI is monitored in city groupings known as metropolitan statistical areas (MSAs) which are defined by the Office of Management and Budget. For each pollutant in the index, the concentration is converted into index values between 0 and 500, “normalized” so that an index value of 100 represents the short term, health-based standard for that pollutant as established by EPA (EPA 1999). The higher the index value, the greater the level of air pollution and health risk. An index value of 500 reflects a risk of imminent and substantial endangerment to public health. The level of the pollutant with the highest index value is reported as the AQI level for that day. An AQI value greater than 100 means that at least one criteria pollutant has reached levels at which people in sensitive groups are likely to experience health effects.

This indicator is based on the percentage of days across all large MSA’s (500,000 people or more) during the sampling season that record an AQI greater than 100 at one or more monitoring sites in the MSA. The air quality data consist of daily (24-hour) measurements for PM10 and PM 2.5 and continuous (1-hour) measurements for CO, NO2, O3, and SO2. The data come from a subset of ambient monitoring sites that meet the trends requirements in Appendix B of the National Air Quality and Emissions Trends Report, 2003 (EPA 2003).

What the Data Show

The number of days with AQI greater than 100 in 93 large Metropolitan Statistical Areas nationwide was 1,649 in 1990 and 1,207 in 2003 (Figure 001-1). The percentage of days with AQI greater than 100 in 2003 is 27% lower than that for 1990. Of the five criteria pollutants in the AQI, only four (CO, O3, PM10, and SO2) usually exhibit values higher than 100; since 1993, ozone has been responsible for between 96 and 98% of these days.

Trends in AQI in the EPA Regions have been consistent with the nationwide trend over the last 13 years (Figure 001-2). In five of the EPA regions (2, 4, 6, 9, and 10), the percentage of days with AQI greater than 100 generally decreased between 1990 and 2003; in three EPA regions (5, 7, and 8), the percentage of days with AQI greater than 100 generally increased during this time period. In EPA Regions 1 and 3, the percentage of days with AQI greater than 100 in 1990 show no general trend, although in Region 3 the percentage of days with AQI greater than 100 in 2004 was lower than the percentage of days in 1990.

Indicator Limitations

- The AQI does not address hazardous air pollutants (HAPs).
- Air quality may vary across a single MSA. In assigning a single number for each pollutant in each MSA, the AQI does not reflect this potential variation.

- The data for this indicator does not reflect MSA's smaller than 500,000 or rural areas.
- The AQI does not show which pollutant(s) are causing the days with an AQI of more than 100, or distinguish between days >100 and days with much higher AQIs.
- This composite AQI indicator does not show which specific MSAs, or how many MSAs, have problems—a specific number of days could reflect a few areas with persistent problems or many areas with occasional problems.

Data Sources

The data source for this indicator is “Air Trends: Metropolitan area trends,” Table A-16, National Air Quality and Emissions Trends Report, 2003. (See Appendix A)

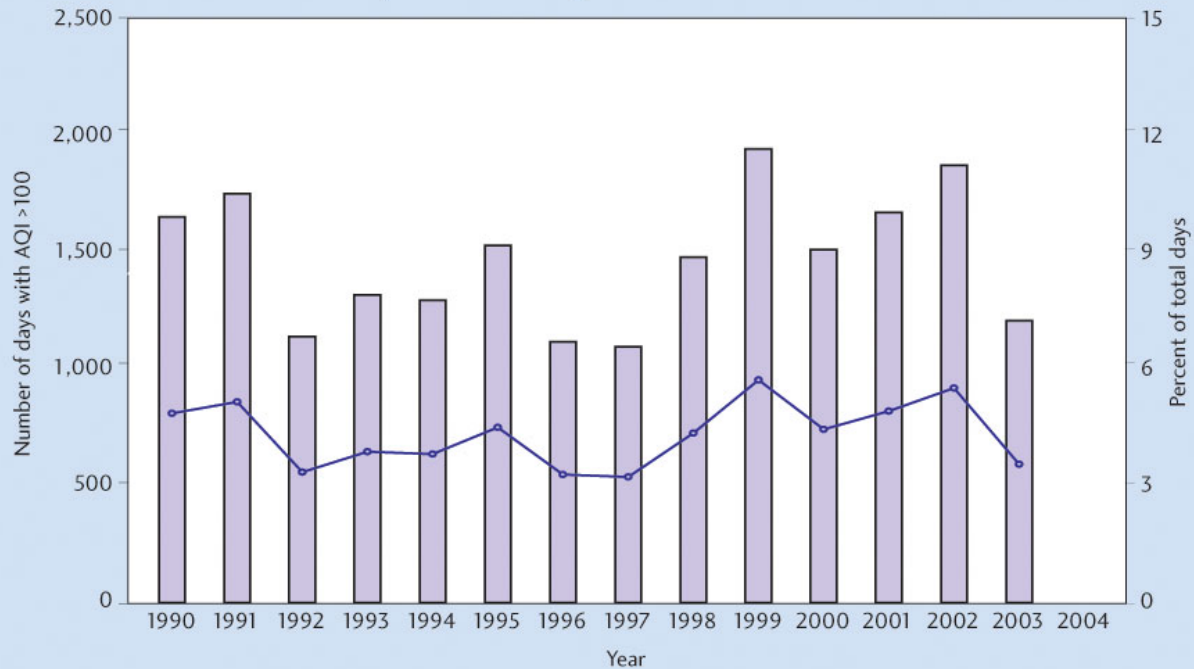
References

U.S. Environmental Protection Agency. National Air Quality and Emissions Trends Report - 2003 Special Studies Edition, EPA 454/R-03-005. Research Triangle Park, NC; US Environmental Protection Agency, Office of Air Quality Planning and Standards, September 2003.

U.S. Environmental Protection Agency. Air Quality Index Reporting, 40 CFR Part 58, August 1999..
http://www.epa.gov/ttn/oarpg/t1/fr_notices/airqual.pdf

Graphics

Figure 001-I: Number and percentage of days with
Air Quality Index (AQI) greater than 100, 1990-2004

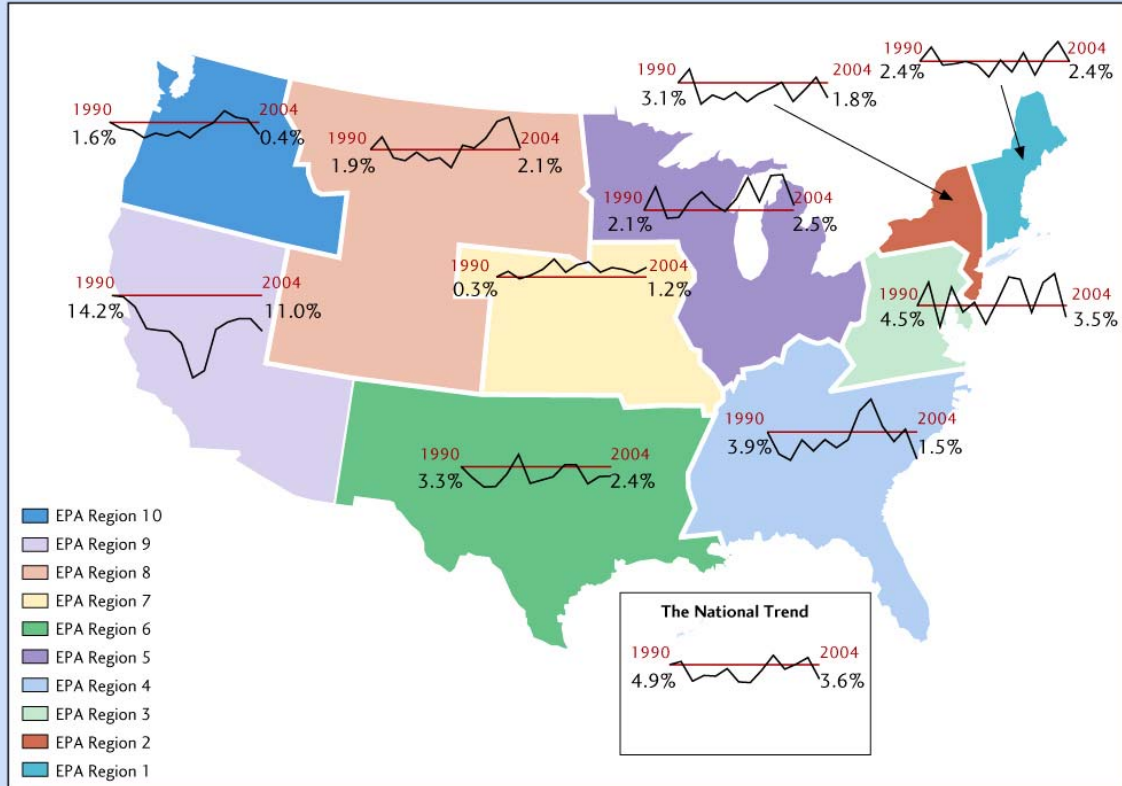


Coverage: Data are for 93 metropolitan statistical areas.

Source: EPA's Air Quality System.

Note: Figure will be updated with 2004 data, once the data are available.

Figure 001-2: Percentage of days with Air Quality Index (AQI) greater than 100, 1990-2004



Source: EPA's Air Quality System.

Note: Figure will be updated with 2004 data, once the data are available.

R.O.E. Indicator QA/QC

Data Set Name: DAYS THAT MSAS HAVE AQI VALUES GREATER THAN 100

Indicator Number: 001 (89068)

Data Set Source: EPA Air Quality Subsystem

Data Collection Date: UNKNOWN

Data Collection Frequency: Varies. See 40 CFR Parts 53 & 58 & attached QA/QC

Data Set Description: Days that MSAs have AQI values greater than 100

Primary ROE Question: What are the trends in outdoor air quality and effects on human health and ecological systems?

Question/Response

T1Q1 Are the physical, chemical, or biological measurements upon which this indicator is based widely accepted as scientifically and technically valid?

The AQI integrates information on pollutant concentrations across an entire monitoring network into a single number that represents the worst daily air quality experienced in an urban area. For each of the pollutants, concentrations are converted into index values between 0 and 500. The index is normalized across each pollutant so that, generally, an index value of 100 is set at the level of the short-term, health-based standard for that pollutant. An index value of 500 is set at the significant harm level, which represents imminent and substantial endangerment to public health. The higher the index value, the greater the level of air pollution and health risk. The Guideline for Reporting of Daily Air Quality Air Quality Index (AQI), EPA-454/R-99-010, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, July 1999, contains the equations used to calculate the AQI. This document can be downloaded at <http://www.epa.gov/ttn/oarpg/t1/memoranda/rg701.pdf>

T1Q2 Is the sampling design and/or monitoring plan used to collect the data over time and space based on sound scientific principles?

Yes. In 2002, thousands of monitoring sites reported air quality data for one or more of the six National Ambient Air Quality Standards (NAAQS) pollutants to AQS. The sites consist of National Air Monitoring Stations (NAMS), State and Local Air Monitoring Stations (SLAMS), and other special-purpose monitors. NAMS were established to ensure a long-term national network for urban area-oriented ambient monitoring and to provide a systematic, consistent database for air quality comparisons and trends analysis. SLAMS allow state or local governments to develop networks tailored for their immediate monitoring needs. The monitoring objectives for the NAMS/SLAMS network are found in: " 40 CFR 58, Appendix D <http://www.epa.gov/ttn/amtic/> " 40 CFR 58.2(c) " EPA 454/R-98-004, Part I, Section 3.2 <http://www.epa.gov/ttn/amtic/cpreldoc.html> In the case of PM, many areas use non-Federal Reference Method monitors (continuous PM monitors such as TEOM monitors) for the purpose of reporting the AQI. Before using these monitors, state must establish a linear relationship between concentrations from a Federal Reference or Equivalent Method and a non-reference method monitor for the purpose of reporting PM values in the AQI. EPA's Air Quality Index (AQI), monitors air quality in selected city groupings known as metropolitan statistical areas (MSAs). MSAs are defined by the Office of Management and Budget and generally include one or more entire counties, except in New England where cities and towns are the basic geographic units. MSAs have been selected as the reporting unit because they are the basis for listings of attainment and nonattainment status for National Ambient Air Quality Standards (NAAQS).

T1Q3 Is the conceptual model used to transform these measurements into an indicator widely accepted as a scientifically sound representation of the phenomenon it indicates?

Yes. EPA compiles and processes outdoor air quality data to generate the AQI. The AQI is an index for reporting daily air quality for a given location and is a key tool in EPA's efforts to make air quality data accessible and useful to the general public. It indicates how clean or how polluted the outside air is. Based on monitoring data, the AQI gives a daily score of 1 to 500 for each pollutant monitored in each MSA. An AQI of 100 means the outdoor air concentration is generally no higher than the respective NAAQS. For example, an AQI of 50 means good air quality, whereas an AQI of 300 means poor air quality. The AQI for particulate matter is a special case, in that day counts are derived slightly differently. AQI levels for particulate matter are best estimated from daily particulate matter monitors, and, therefore, the nation's air programs are installing more continuous particulate matter monitors. However, when using EPA's Federal Reference Method (FRM) data, the non-daily sampling schedules for particulate matter (e.g., one sample per 3 days) can affect the observed day counts. Therefore, EPA is evaluating methods for adjusting the counts for particulate matter days with an AQI over 100. The easiest method to adjust particulate matter counts, and that currently being used, is based on a simple ratio of the number of days in a quarter to the number of days with at least one sample in an MSA. The ratio is multiplied times the actual number of days in the quarter with the AQI above 100 for particulate matter to get an adjusted quarterly count, which can then be used to calculate an annual number. For example, if there are 90 days in a quarter and 15 sampling days in that quarter, the ratio of 90:15, or 6, is used to adjust the count of days with an AQI over 100 for particulate matter. Thus, if there are 2 days with sample values resulting in an AQI greater than 100, the count is adjusted to 12 days with an AQI greater than 100. EPA maintains a Web site that fully explains the derivation of the AQI and its interpretation and use at <http://www.epa.gov/airnow/aqibroch/aqi.html#1>

T2Q1 To what extent is the indicator sampling design and monitoring plan appropriate for answering the relevant question in the ROE?

The air quality data consist of daily (24-hour) measurements for PM₁₀ and PM_{2.5} and continuous (1-hour) measurements for CO, NO₂, O₃, and SO₂.¹ The daily measurements for particulate matter are taken from monitoring instruments that produce one 24-hour measurement and typically operate on a systematic sampling schedule of once every 6 days, or 61 samples per year. In other words, these instruments generate one 24-hour sample every 6 days. EPA has determined that these 61 daily samples adequately represent outdoor air quality throughout the year. Monitoring instruments for CO, NO₂, O₃, and SO₂ operate continuously and produce a measurement every hour for a possible total of 8,760 hourly measurements in a year.

T2Q2 To what extent does the sampling design represent sensitive populations or ecosystems?

The data for this indicator are associated with large MSAs only (500,000 people or more); therefore, the data tend to reflect urban air quality. Also, This composite AQI indicator does not show which areas, or how many areas, have problems a specific number of days could reflect a few areas with persistent problems or many areas with occasional problems. The network does not explicitly target sensitive populations such as asthmatics, the elderly, or children.

T2Q3 Are there established reference points, thresholds or ranges of values for this indicator that unambiguously reflect the state of the environment?

The index is normalized across each pollutant so that, generally, an index value of 100 is set at the level of the shortterm, health-based standard for that pollutant. An index value of 500 is set at the significant harm level, which represents imminent and substantial endangerment to public health. To make the AQI as easy to understand as possible, EPA has divided the AQI scale into six general categories that correspond to a different level of health concern: " Good (0 50): Air quality is considered satisfactory, and air pollution poses little or no risk. " Moderate (51 100): Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of individuals. For example, people who are unusually sensitive to ozone may experience respiratory symptoms. " Unhealthy for Sensitive Groups (101 150): Certain groups of people may be particularly sensitive to the harmful effects of certain air pollutants. This means they are likely to be affected at lower levels than is the general public. For example, people with respiratory disease are at greater risk from exposure to ozone, while people with respiratory disease or heart disease are at greater risk from particulate matter. When the AQI is in this range, members of sensitive groups may experience health effects, but the general public is not likely to be affected. " Unhealthy (151 200): Everyone may begin to experience health effects. Members of sensitive groups may experience more serious health effects. " Very Unhealthy (201 300): Air quality in this range triggers a health alert, meaning everyone may experience more serious health effects. " Hazardous (over 300): Air quality in this range triggers health warnings of emergency conditions. The entire population is more likely to be affected.

T3Q1 What documentation clearly and completely describes the underlying sampling and analytical procedures used?

National Air Quality and Emissions Trends Report, 2003 Special Studies Edition - <http://www.epa.gov/air/airtrends/aqtrnd03/> General Air Quality and National Monitoring Network - <http://www.epa.gov/ttn/amtic/moninfo.html> PM 2.5 Monitoring Information - <http://www.epa.gov/ttn/amtic/amticpm.html>

T3Q2 Is the complete data set accessible, including metadata, data-dictionaries and embedded definitions or are there confidentiality issues that may limit accessibility to the complete data set?

Table A-17 and A-18 in Appendix A of the National Air Quality and Emissions Trends Report, 2003 contains the AQI indicator data. This data can be downloaded from the internet at <http://www.epa.gov/air/airtrends/aqtrnd03/appenda.pdf>

T3Q3 Are the descriptions of the study or survey design clear, complete and sufficient to enable the study or survey to be reproduced?

Yes, The pollutant concentration data is from the State and Local Air Monitoring Stations (SLAMS) operating under the rules set forth in Part 58 of 40 CFR. In the case of PM, many areas use non-Federal Reference Method monitors (continuous PM monitors such as TEOM monitors) for the purpose of reporting the AQI. Before using these monitors, state must establish a linear relationship between concentrations from a Federal Reference or Equivalent Method and a non-reference method monitor for the purpose of reporting PM values in the AQI. EPA's Air Quality Index (AQI), monitors air quality in selected city groupings known as metropolitan statistical areas (MSAs). MSAs are defined by the Office of Management and Budget and generally include one or more entire counties, except in New England where cities and towns are the basic geographic units.

T3Q4 To what extent are the procedures for quality assurance and quality control of the data documented and accessible?

AQI information is presented for those air quality data that meet EPA's data quality requirements. (For more information on EPA's data quality requirements, see Appendix B Metropolitan Area Trends of the Trends Report at <http://www.epa.gov/airtrends/metro.html>) Also, there is a Quality Assurance Project Plan from each state or local agency operating a NAMS/SLAMS monitor meeting the AEPA Requirements for Quality Assurance Project Plans@, EPA QA/R-5. The quality assurance plans for specific sites are publicly available by request to the reporting agency or the corresponding EPA Regional Office. The plans are audited at least once every three years as required in 40 CFR 58, Appendix A, Section 2.5. In addition, the data repository itself (i.e., AQS) provides direct access to two of the more prominent quality assurance indicators (i.e., precision and accuracy).

T4Q1 Have appropriate statistical methods been used to generalize or portray data beyond the time or spatial locations where measurements were made (e.g., statistical survey inference, no generalization is possible)?

Yes, EPA compiles and processes outdoor air quality data to generate the AQI. The AQI is an index for reporting daily air quality for a given location and is a key tool in EPA's efforts to make air quality data accessible and useful to the general public. It indicates how clean or how polluted the outside air is. Based on monitoring data, the AQI gives a daily score of 1 to 500 for each pollutant monitored in each MSA. An AQI of 100 means the outdoor air concentration is generally no higher than the respective NAAQS. For example, an AQI of 50 means good air quality, whereas an AQI of 300 means poor air quality. The AQI for particulate matter is a special case, in that day counts are derived slightly differently. AQI levels for particulate matter are best estimated from daily particulate matter monitors, and, therefore, the nation's air programs are installing more continuous particulate matter monitors. However, when using EPA's Federal Reference Method (FRM) data, the non-daily sampling schedules for particulate matter (e.g., one sample per 3 days) can affect the observed day counts. Therefore, EPA is evaluating methods for adjusting the counts for particulate matter days with an AQI over 100. The easiest method to adjust particulate matter counts, and that currently being used, is based on a simple ratio of the number of days in a quarter to the number of days with at least one sample in an MSA. The ratio is multiplied times the actual number of days in the quarter with the AQI above 100 for particulate matter to get an adjusted quarterly count, which can then be used to calculate an annual number. For example, if there are 90 days in a quarter and 15 sampling days in that quarter, the ratio of 90:15, or 6, is used to adjust the count of days with an AQI over 100 for particulate matter. Thus, if there are 2 days with sample values resulting in an AQI greater than 100, the count is adjusted to 12 days with an AQI greater than 100. EPA maintains a Web site that fully explains the derivation of the AQI and its interpretation and use at <http://www.epa.gov/airnow/aqibroch/aqi.html#1>

T4Q2 Are uncertainty measurements or estimates available for the indicator and/or the underlying data set?

No

T4Q3 Do the uncertainty and variability impact the conclusions that can be inferred from the data and the utility of the indicator?

Air quality may vary across a single MSA. In assigning a single symbol for each pollutant in each MSA, the AQI does reflect this potential variation.

T4Q4 Are there limitations, or gaps in the data that may mislead a user about fundamental trends in the indicator over space or time period for which data are available?

AQI is designed to address CO, NO₂, O₃, particulate matter (PM₁₀ and PM_{2.5}), and SO₂. Also, the indicator as a national trend does not contain information about exceedances of the AQI for more than one pollutant during any particular day. EPA acknowledges that the general public is not always familiar with MSAs. For example, users living in small towns may not realize they are part of an MSA named for a nearby larger town. Furthermore, not all areas in the country are in MSAs. Those MSAs with small populations, those with air quality that is so good that AQI reporting is not currently required, and those with too little monitoring data would not be included. Also, the general public is not always familiar with MSAs. For example, users living in small towns may not realize they are part of an MSA named for a nearby larger town. Furthermore, not all areas in the country are in MSAs, and not all MSAs would be included in this display. Those MSAs with small populations, those with air quality that is so good that AQI reporting is not currently required, and those with too little monitoring data would not be included. Also, the general public is not always familiar with MSAs. For example, users living in small towns may not realize they are part of an MSA named for a nearby larger town. Furthermore, not all areas in the country are in MSAs, and not all MSAs would be included in this display. Those MSAs with small populations, those with air quality that is so good that AQI reporting is not currently required, and those with too little monitoring data would not be included. Also, the general public is not always familiar with MSAs. For example, users living in small towns may not realize they are part of an MSA named for a nearby larger town. Furthermore, not all areas in the country are in MSAs, and not all MSAs would be included in this display. Those MSAs with small populations, those with air quality that is so good that AQI reporting is not currently required, and those with too little monitoring data would not be included. Also, the general public is not always familiar with MSAs. For example, users living in small towns may not realize they are part of an MSA named for a nearby larger town. Furthermore, not all areas in the country are in MSAs, and not all MSAs would be included in this display. Those MSAs with small populations, those with air quality that is so good that AQI reporting is not currently required, and those with too little monitoring data would not be included.